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Lead Scientist's Report

Summary: This report includes five items: (1) summary of one article from *Restoration Ecology* on implementing adaptive management in the restoration of the Columbia River estuary; (2) summary of one article from *Biological Conservation* on winter-run Chinook salmon habitat use; (3) summary of the Salmon Disease Ecology Workshop; (4) summary of the Interagency Ecological Program Workshop, (5) By the Numbers Report.

Estuary Ecosystem Restoration: Implementing and Institutionalizing Adaptive Management. Ebberts, Blaine D.; Zelinsky, Ben D.; Karnezis, Jason P.; et al. *Restoration Ecology*. March 2018.

Even as ecosystem restoration adaptive management (AM) frameworks are becoming more and more common, effective, long-term implementation of AM frameworks remains a challenge. This paper highlights how managers embedded and institutionalized AM into the work flow of the Colombia Estuary Ecosystem Restoration Program (CEERP). The authors highlight that institutionalizing AM into restoration planning is essential to successful implementation.

The goal of CEERP is to understand, conserve, and restore ecosystems in the Colombia River Estuary, including the lower, tidally-influenced portion of the river and adjacent floodplains. The restoration efforts for the CEERP are largely a result of recommendations put forward through Biological Opinions to mitigate impacts affecting 13 listed populations of salmon and steelhead. The primary strategy is to restore water flows in wetland areas that historically were connected to the main estuary but have been diked or impacted in other ways. Four programmatic principles led the AM process to ensure that the program is (1) implementable (cost-effective, feasible, and reasonable), (2) non-redundant (using existing processes), (3) collaborative, and (4) science based. As a result of a decade of AM efforts, CEERP managers have identified the value of an adaptive approach, e.g., in reevaluating the use of dredge materials in habitat creation, and reaffirming that hydrological reconnection improves ecosystem function for salmonids. This AM process has been fundamental to 50 projects, with 3,700 acres of habitat restored, and 2,500 acres acquired.

Managers involved with CEERP attribute the following eight points as the most crucial elements for implementing and institutionalizing AM: (1) have a common goal; (2) establish and consistently implement a governance and decision-making structure; (3) share data and information; (4) undertake routine formal and informal coordination and communication activities; (5) work to earn commitment and buy-in to the AM process and the restoration program; (6) embrace independent scientific peer review; (7) resolve conflicts and cooperate with each other; and (8) be dedicated to implementing the AM process. These elements are applicable to similar large-scale ecosystem restoration programs, including here in the Delta.

Endangered Winter-Run Chinook Salmon Rely on Diverse Rearing Habitats in a Highly Altered Landscape. Phillis, Corey C.; Sturrock, Anna M.; Johnson, Rachel C.; and Weber, Peter K. *Biological Conservation*. January 2018.

Identifying essential habitat is an important component of conserving endangered species. For migratory species like Chinook salmon, identifying essential habitat requires tracking them through their broad geographic range and pinpointing locations that affect survivorship and

growth. The focus of critical habitat for endangered winter-run Chinook salmon has been on the main stem of the Sacramento River to the Golden Gate, including the western margin of the Delta, but it does not include tributaries to the Sacramento River or much of the Delta. Our understanding of habitat use by juvenile salmon moving down the river has relied primarily on acoustic tagging of older juveniles and monitoring stations in the main stem of the river. Phillis and his colleagues used advancements in evaluating the strontium isotopic composition of otoliths (a part of the fishes' inner ear) to reconstruct the migration of juvenile winter-run Chinook salmon. Strontium isotopes vary in different rivers of the California Central Valley, and these differences are "recorded" in an individual fish's otolith, making it possible to identify where spawning adult fish have spent time as juveniles.

Adult winter-run Chinook were collected from the Livingston Stone National Fish Hatchery in the 2007-2009 May-June spawning season. The researchers identified four unique "rearing groups" from these fish based on the isotopic composition of their otoliths. The majority of winter-run Chinook salmon that were examined spent at least three weeks rearing in habitats that are outside of their designated critical habitat, i.e., the main stem of the Sacramento River. These newly identified areas include Lassen tributaries, the Feather River, American River, and the Delta, with between seven and 23 percent of the salmon spending time in Feather River or Delta across the three years of the study. This analysis reveals that Winter-run Chinook are using a wider range of habitats than just the Sacramento River, with important implications for future restoration opportunities on tributaries and in the Delta, including consideration for inclusion as critical habitat.

Salmon Disease Ecology Symposium

On March 14, 2018, the Delta Science Program hosted a symposium on pathogens in Pacific salmon. The symposium was held in collaboration with the UC Davis Coastal and Marine Sciences Institute and the Metropolitan Water District of Southern California. Along the west coast of the United States and elsewhere, pathogens (e.g., parasites, bacteria, and viruses) have been linked to salmon mortality and population declines; however, the extent to which pathogens affect salmon populations in the Bay-Delta region is unclear. Investigating potential impacts of pathogens is essential because salmon play key ecological, social, and economic roles in California. In economic terms, it was stated that one salmon caught recreationally represents approximately $1,000 in economic input. The symposium allowed scientists and managers to look ahead and consider potential future challenges that have shown to be a significant problem in other systems, with insight presented from the Klamath River, the Columbia River, British Columbia, and Ireland.

The symposium included three sessions: 1) current knowledge and methods of study, 2) case studies, and 3) key information and knowledge gaps necessary to manage pathogens in wild and cultured salmon populations. Important themes throughout the day included the need for increased collaboration and increased monitoring to assess pathogen impacts. In the Columbia River Basin, research shows that if a juvenile salmon displays no signs of pathogens, it is up to 4.5 times more likely to return as an adult than if it did show signs. While pathogens may play a similarly important role in the Delta, the lack of a comprehensive pathogen monitoring program limits our understanding of potential impacts.

The day following the symposium, invited speakers and organizers convened for a one-day workshop to review highlights and key messages, and to outline a paper that will synthesize

findings from the event. The authors plan to publish their paper in a peer-reviewed journal, a value step towards identifying a framework for salmon disease management in the Bay-Delta.

Interagency Ecological Program Workshop

On March 6-8, 2018 the Interagency Ecological Program (IEP) hosted its annual workshop at the Lake Natoma Inn in Folsom, CA. The IEP is a consortium of nine State and federal agencies that was established in the 1970s. The IEP collaboratively completes monitoring, research, and synthesis for adaptive management, water project operations, and aquatic ecosystem conditions in the Bay-Delta. The three-day workshop brought together scientists and managers to present and discuss research results and technical analyses from recent IEP efforts. This year's workshop consisted of 15 sessions on topics such as the future of the Bay-Delta science enterprise, impacts of the wet year of 2017, evaluation of restoration projects, endangered species monitoring and modeling, and the human dimension of the Delta.

One recurring theme throughout the conference was an emphasis on the need for improved science communication across a range of audiences. Speakers encouraged scientists to emphasize the relevancy and broader impacts of their research to directors, managers, and other decision-makers; the importance of reciprocal communication from information users and decision-makers to scientists was also highlighted. A second theme was a focus on identifying underlying mechanisms that are driving trends in population dynamics; talks went beyond simply reporting what is happening in the Delta to identify why changes are likely to be occurring. Another important issue that was discussed was the importance of synthesis efforts. Lively discussions took place about barriers to effective science syntheses and potential solutions to remove these barriers.

By the Numbers

Delta Science Program staff will give a summary of current numbers related to Delta water and environmental management. The summary (Attachment 1) will inform the Council of recent counts, measurements, and monitoring figures driving water and environmental management issues.

List of Attachments

Attachment 1: By the Numbers Summary (report to be provided at the Council Meeting)

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